RUN-10 PHENIX REPORT

Baruch COLLEGE The City University of New York
RIKEN BNL Research Center
Stefan Bathe, Users Meeting, 10June2010

Run Schedule

January

Su	Mo	Tu	We	Th	Fr	Sa
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

February

Su	Mo	Tu	We	Th	Fr	Sa
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28						

March

Su	Mo	Tu	We	Th	Fr	Sa
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

April

Su	Mo	Tu	We	Th	Fr	Sa
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

May

Su	Mo	Tu	We	Th	Fr	Sa
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

June

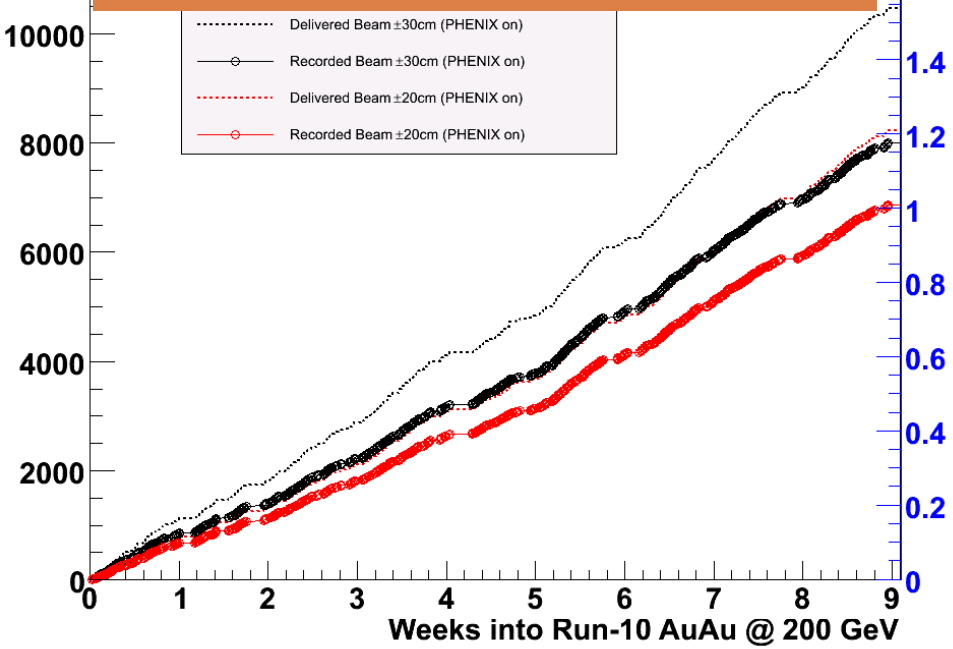
Su	Mo	Tu	We	Th	Fr	Sa
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

Run-10 ends today

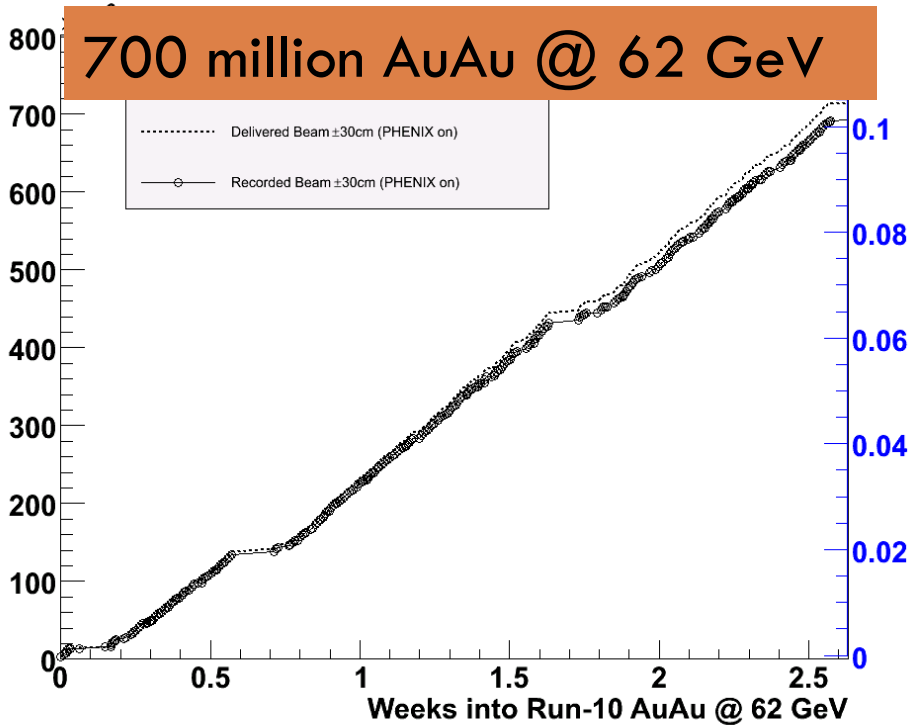
10 weeks @ 200 GeV (10)
2.9 weeks @ 62 GeV (4)
1.9 weeks @ 39 GeV (2)
0.2 weeks @ 2/3 integer working point study
5 weeks @ 7.7 GeV
0.2 weeks @ 5 GeV study (no collisions, just lifetime study)
1.3 week @ 11.5 GeV STAR; *Muon Upgrade Commissioning PHENIX*
0.2 weeks @ APEX
0.2 weeks @ warm-up

all Au+Au

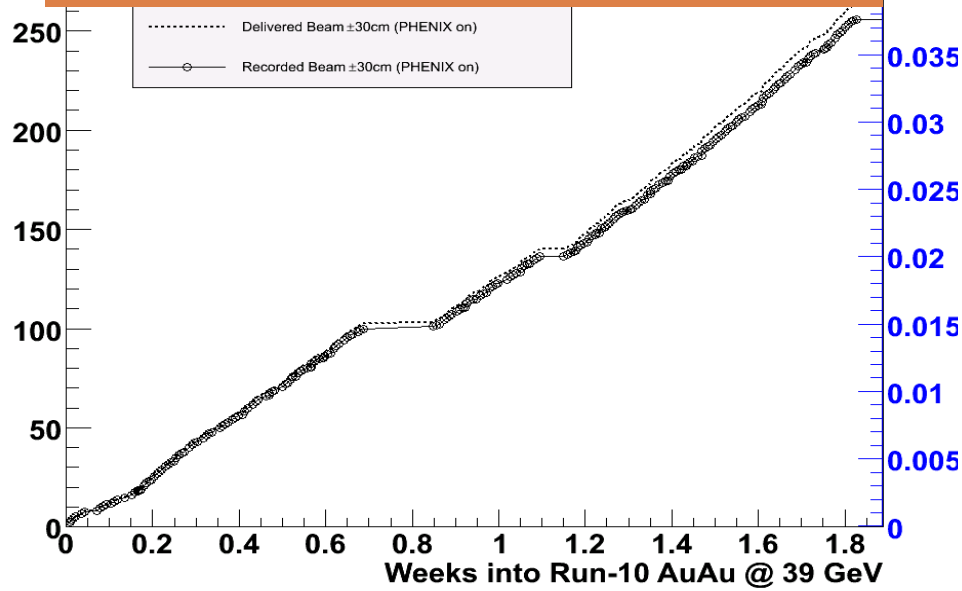
8 billion AuAu @ 200 GeV



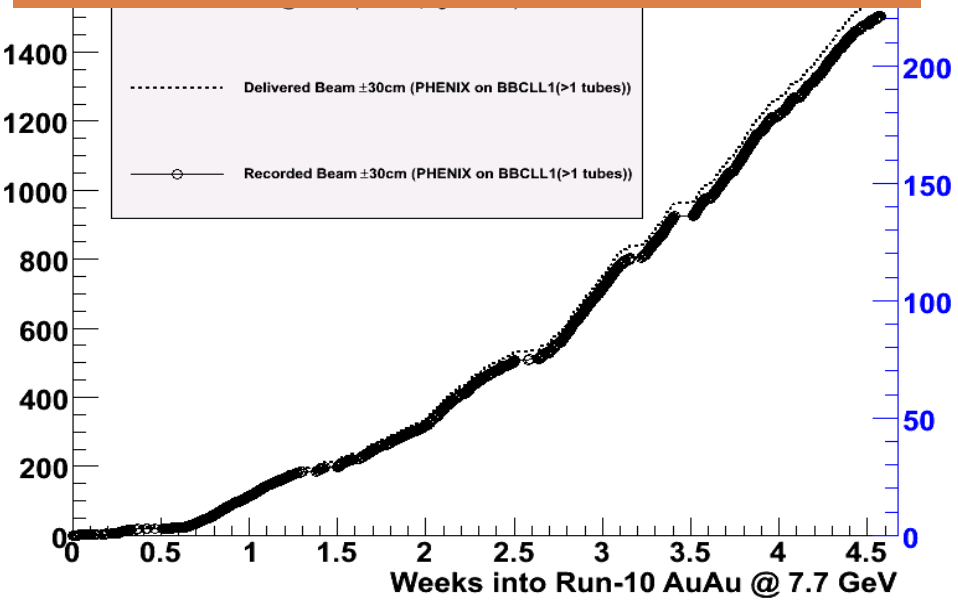
700 million AuAu @ 62 GeV



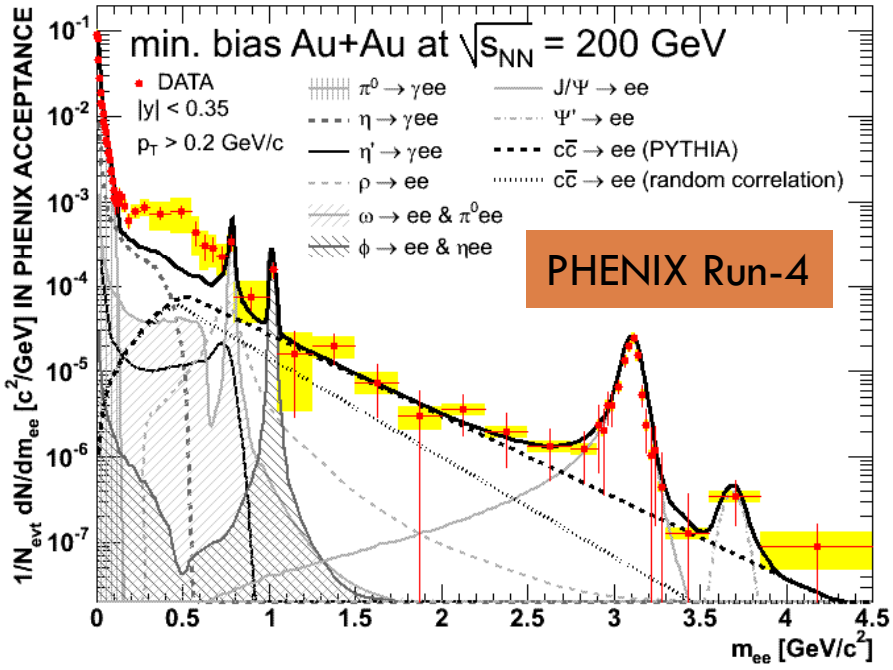
250 million AuAu @ 39 GeV



1.5 million AuAu @ 7.7 GeV



200 GeV Au+Au Goal



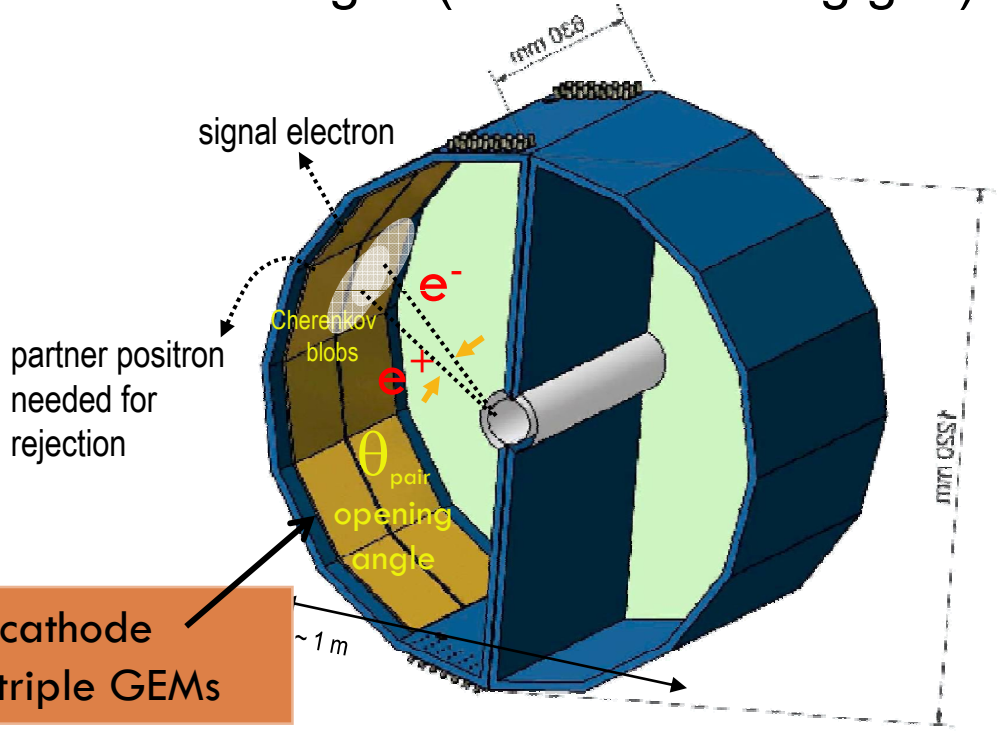
Phys. Rev. C 81, 034911 (2010)

- Study electron continuum in low M_{ee} region
- Measure in medium-modifications of ρ, ω, ϕ
- Chiral symmetry restoration
- Measure temperature (internal conversion of direct photons)

All with HBD

Hadron Blind Detector (HBD)

HBD: novel windowless Cerenkov detector with CF4 gas (radiator/working gas)



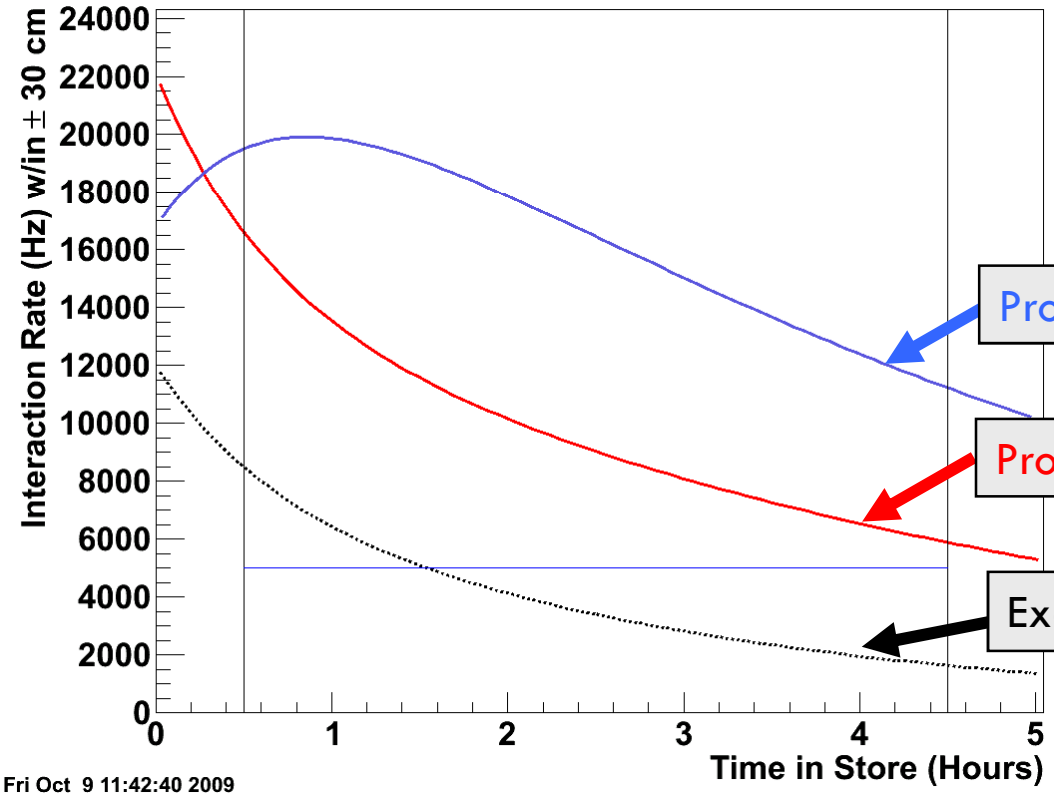
CsI photocathode covering triple GEMs

HBD will greatly improve e+e- pair measurements, including the virtual photon analysis.

Removes background e+e- pairs

Luminosity Expectations 200 GeV

DAQ bandwidth limit of 5 kHz



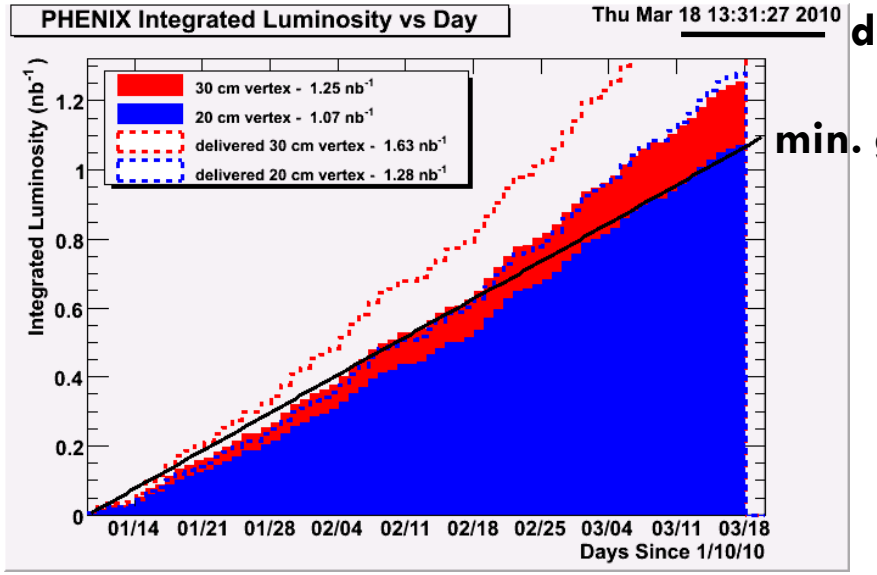
Improvements for Run-10
-DAQ livetime 90 → 98 %
-(Sophisticated) prescaling of minimum bias trigger to keep livetime up
-Different vertex cuts to sample most valuable luminosity

Projection with Vertical Cooling too!

Projection with full Longitudinal Cooling

Example "best" store from Run-07

200 GeV: Jan 10 - Mar 18



desired

min. goal

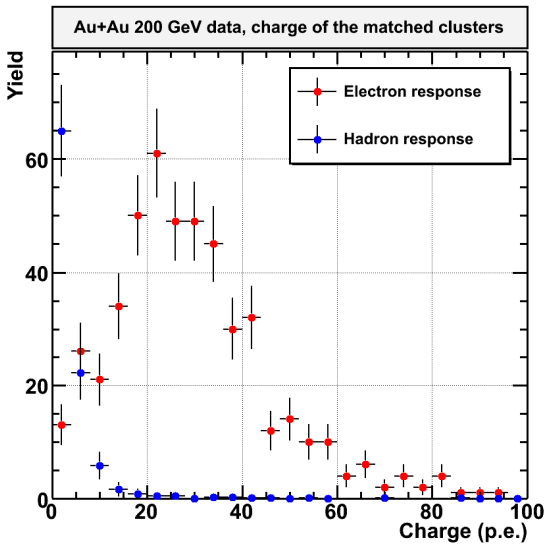
Goal reached.

Success!

- Run-10 data set factor 1.5 larger than Run-7 data and has functioning HBD!

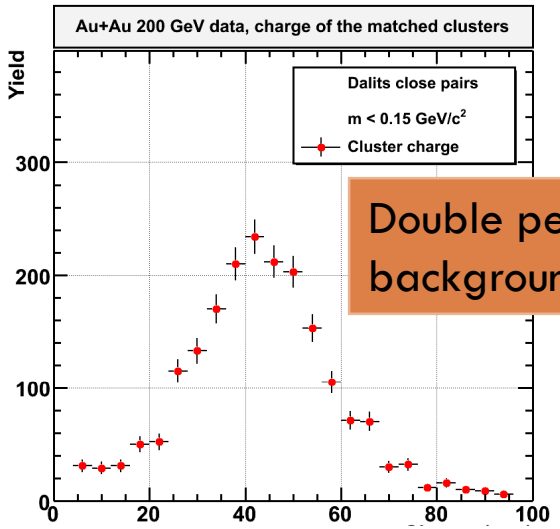
- BUP goal
  - record 1.4 nb^{-1} ($\pm$ 30 cm)
    - realistically 1.1 nb^{-1} ($\pm$ 30 cm) in 10 weeks
- Recorded
  - 8.2 B minimum bias events or 1.3 nb^{-1} ($\pm$30 cm)
  - 7.0 B minimum bias events or 1.1 nb^{-1} ($\pm$ 20 cm)
  - Recorded 77 % (86 %) of min. bias evts. in $\pm$30 cm ($\pm$20 cm)

HBD Performance in 200 GeV Au+Au

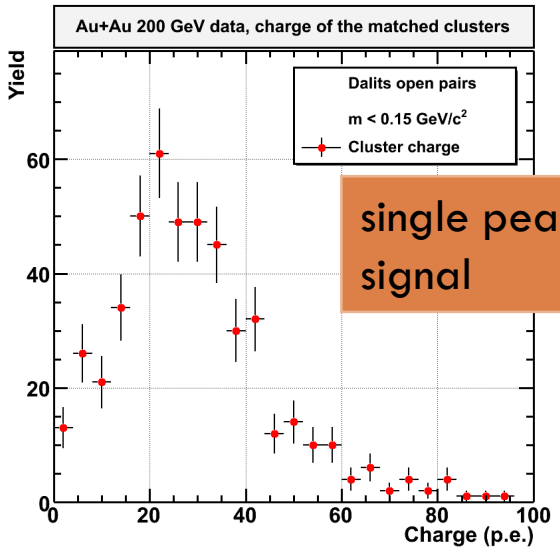


Hadron rejection

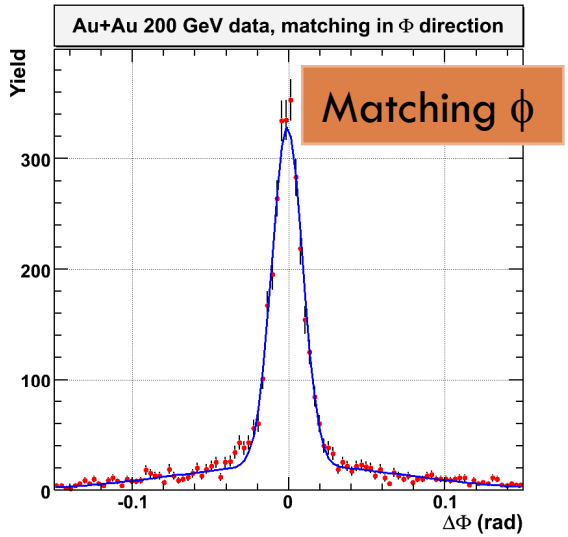
HBD worked as expected



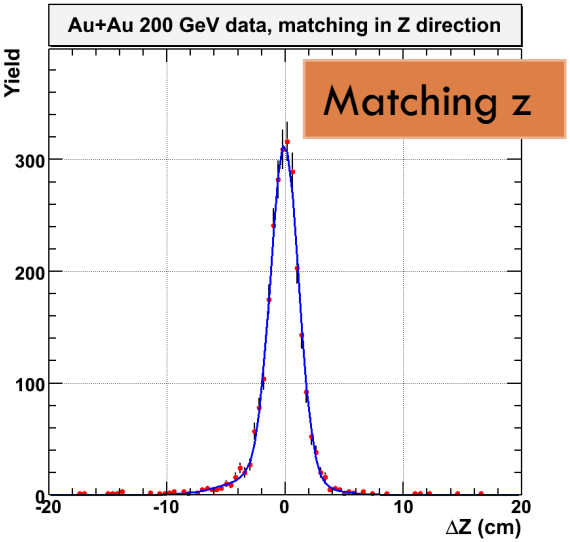
Double peak: background



single peak: signal

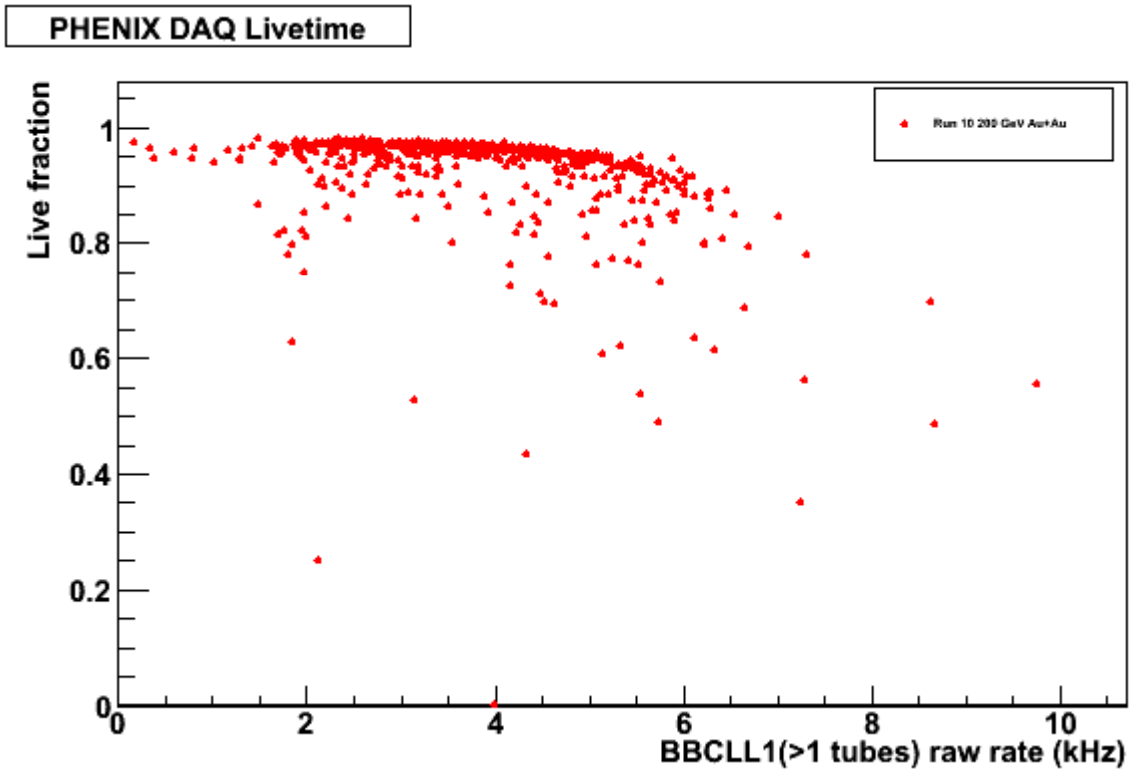


Matching ϕ



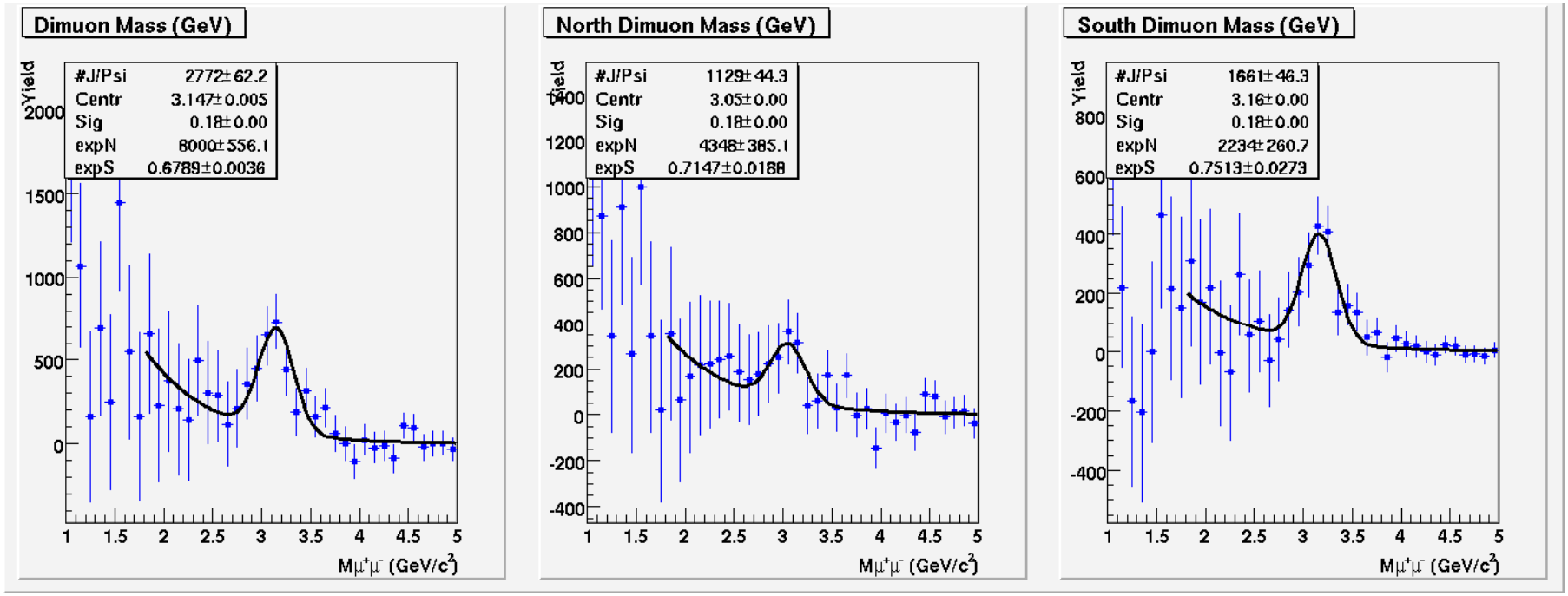
Matching z

DAQ Performance in 200 GeV Au+Au



DAQ livetime > 95 % at up to 5.5 kHz BBC rate

J/ψ in Muon Arms in 200 GeV Au+Au



Analyzed Luminosity (for mass plots):
147.7 μb^{-1} gives 18.8 +- 0.4 (stat) J/Ψ per μb^{-1}
Compared to Run7 Au+Au which had about 18.2 J/Ψ per μb^{-1}

J/ψ yield as expected

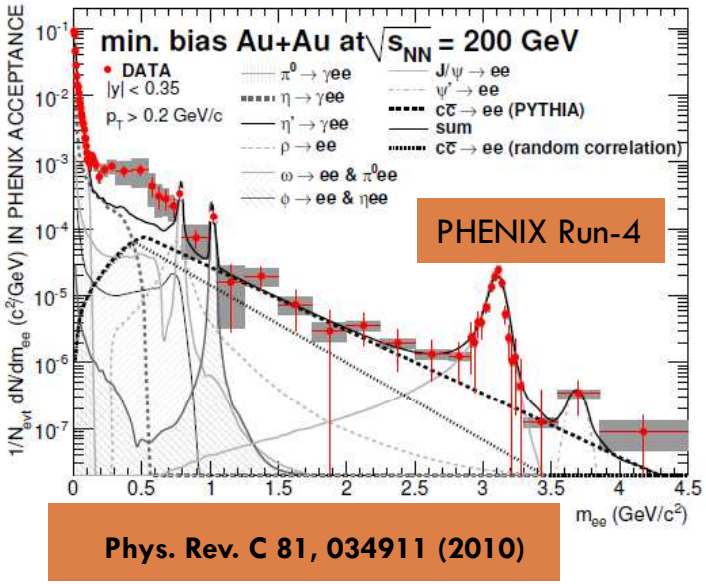
200 GeV success—Now on to 62.4 GeV

62 GeV goal: Dilepton physics

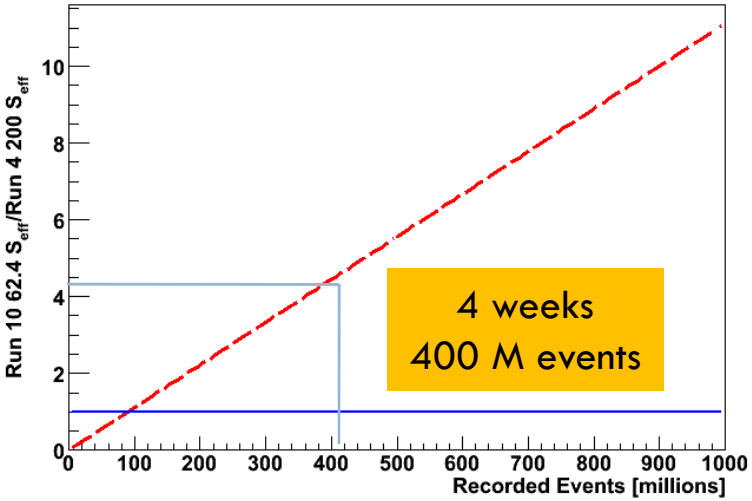
With 400 million recorded AuAu @ 62 GeV minimum bias events in PHENIX, if we assume a similar low mass enhancement to our published Run-04 AuAu @ 200 GeV result, we will have an increase in the statistical significance of 2.

The Run-04 @ 200 GeV low mass enhancement is a 2.6 sigma effect.

Thus, the Run-10 @ 62 GeV result would be a 5.2 sigma effect.

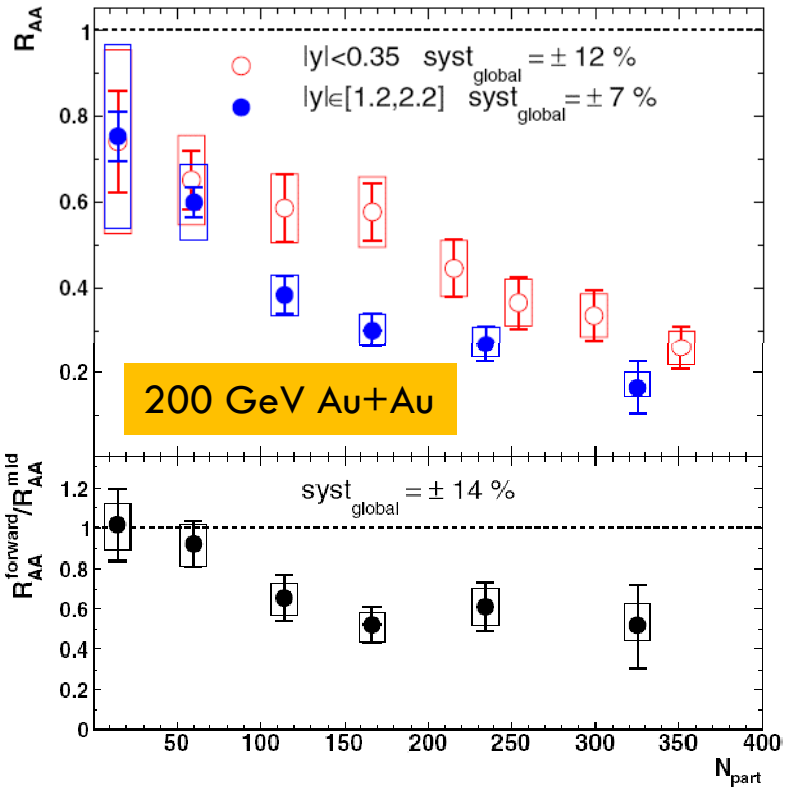


Phys. Rev. C 81, 034911 (2010)



62.4 GeV improvement factor w.r.t. Run-4@200GeV as function of # of events

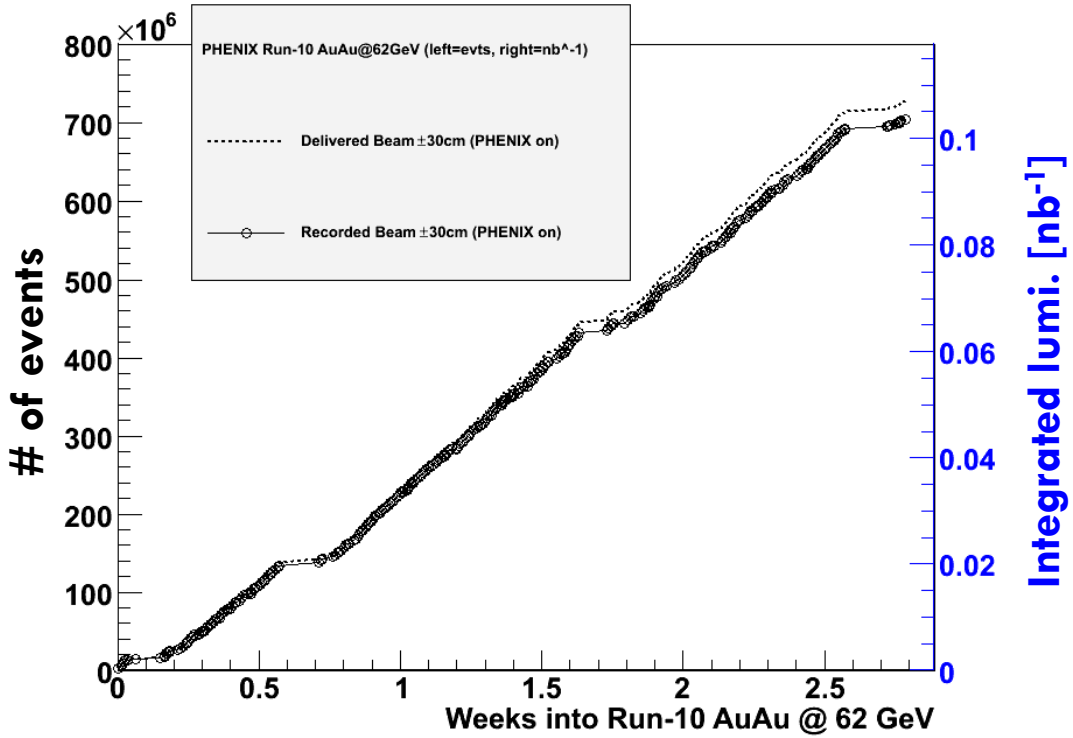
Enhanced goal: J/ψ Measurement at 62 GeV



Phys. Rev. Lett. 98, 232301 (2007)

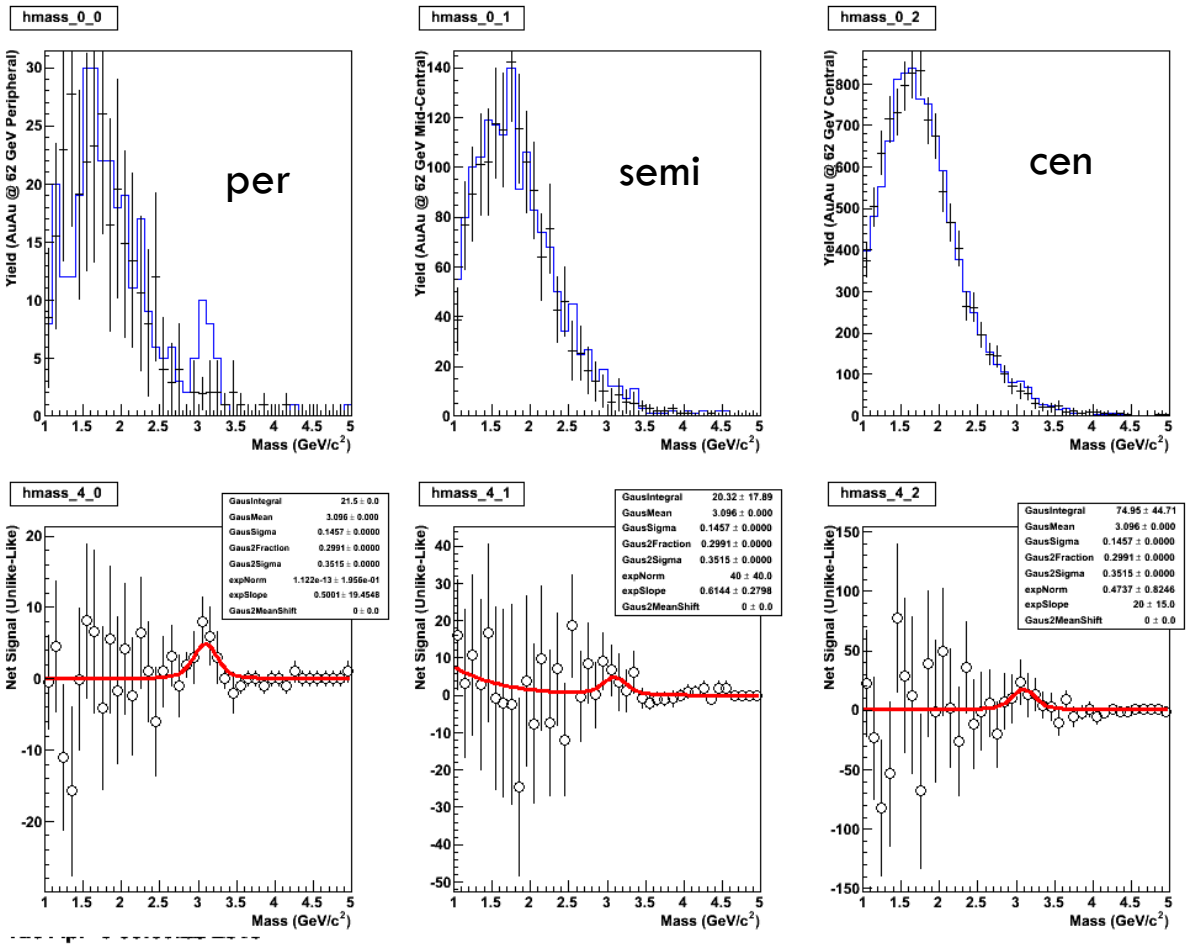
- Performance twice better than expected
- In three weeks of running
  - 600 M min. bias events (recorded)
  - 500 J/ψ
- Measure J/ψ suppression at 62.4 GeV
- Recombination models (Rapp et al.)
  - J/ψ yield at 200 GeV dominated by recombination
  - predict much larger suppression at 62 GeV than at 200 GeV
    - J/ψ yield down 1/3 at 62 GeV
    - Recombination down 1/10
- **Extremely interesting test of recombination models**

62 GeV: Mar 19 – Apr 8



Achieved: 700 M events in 3 weeks
Original HBD goal reached
New J/ψ goal reached also

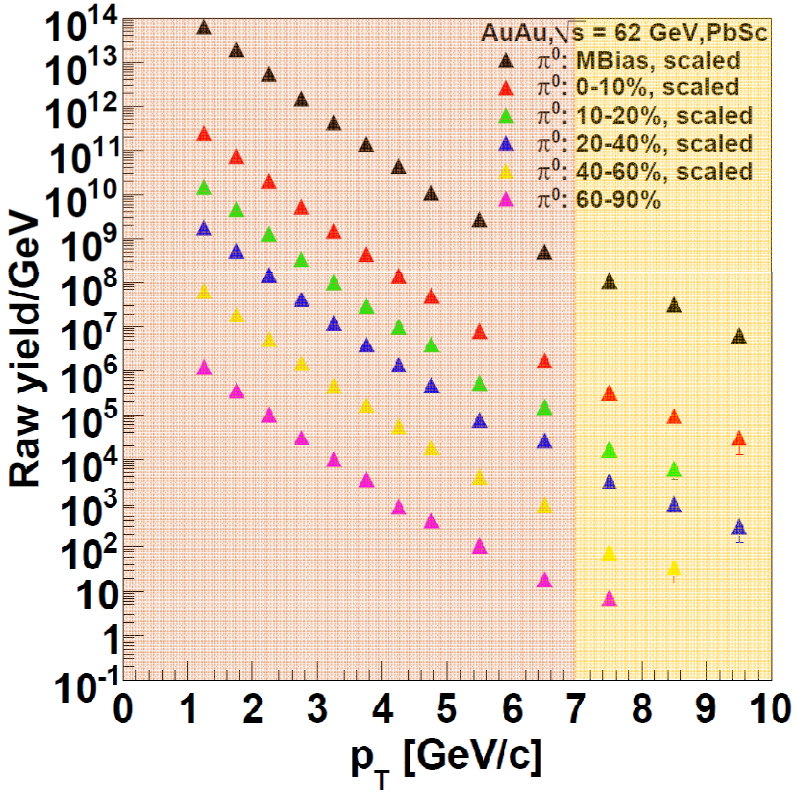
First Glimpse at J/ψ from 62 GeV

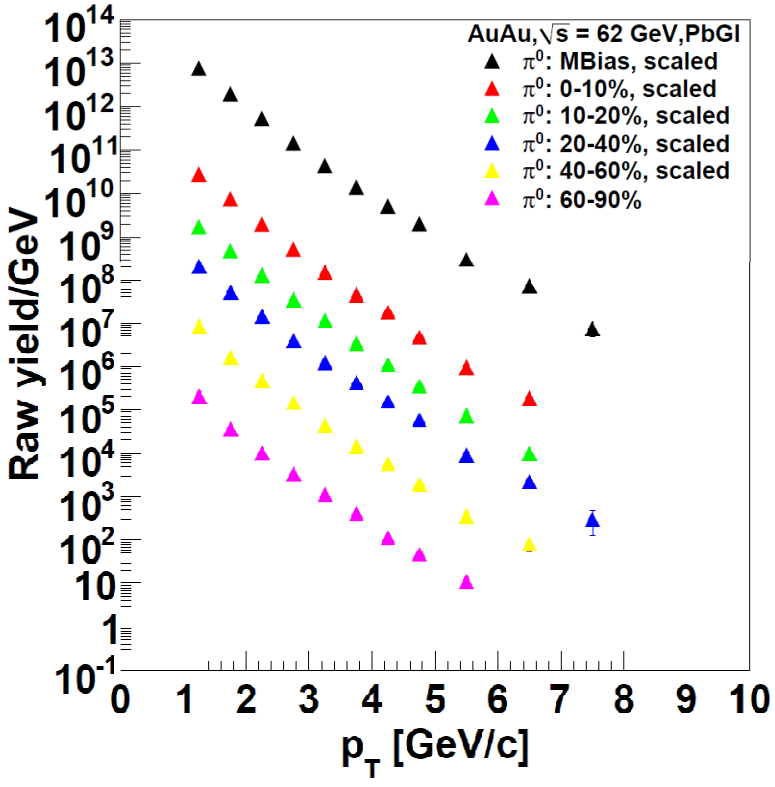


Peak visible from about
25 % of statistics

Encouraging!

π^0 yields (uncorrected) at 62.4 GeV



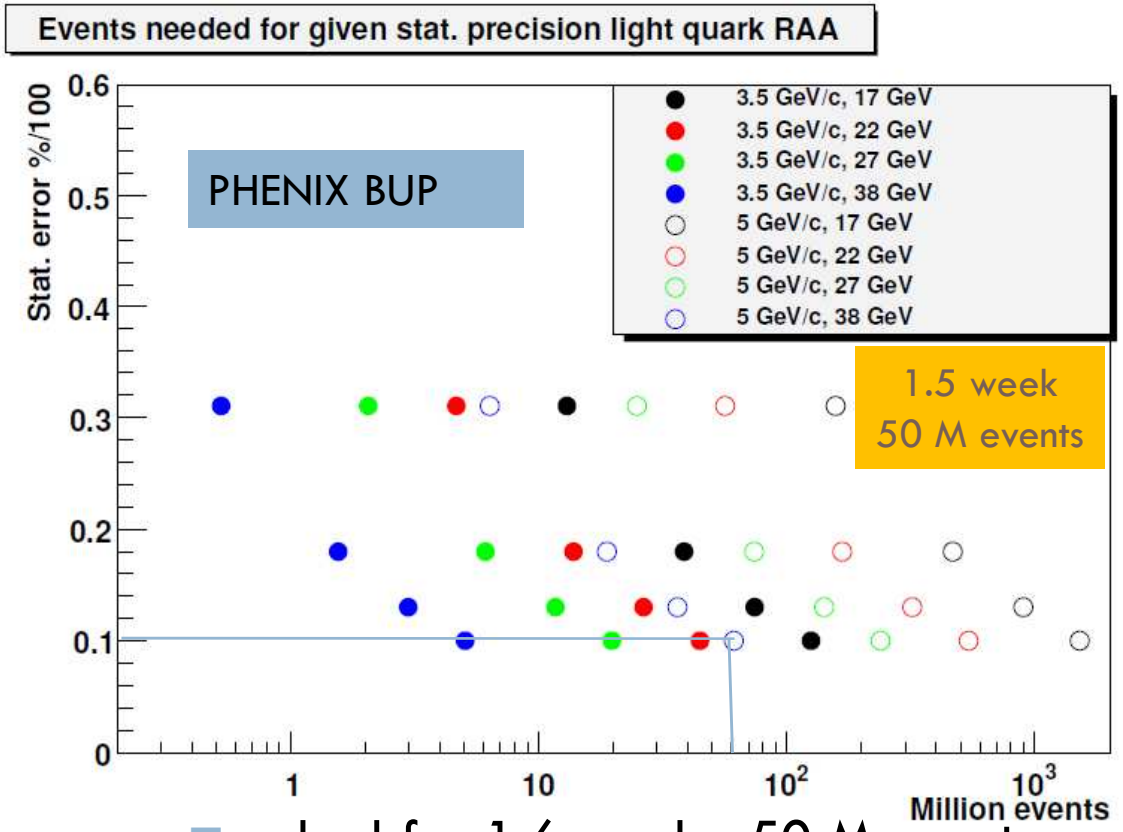


Previous p_T reach (Run-4)

Enhanced p_T reach (Run-10)

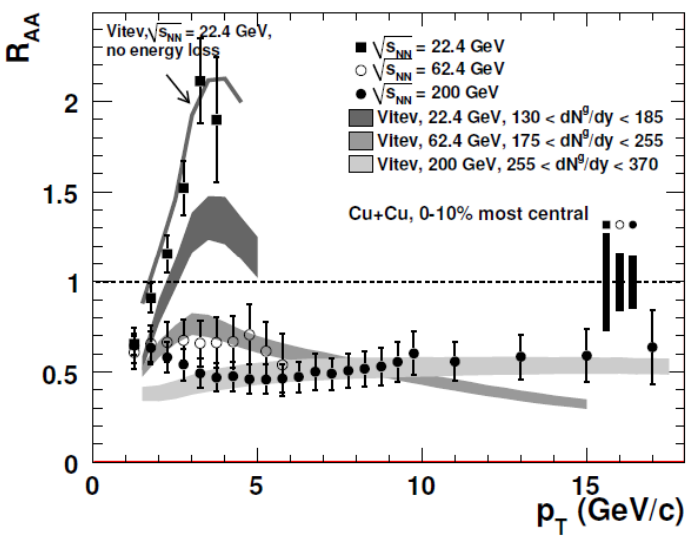
62.4 GeV success—Now on to 39 GeV

Goal: Light Quark R_{AA} at 39 GeV



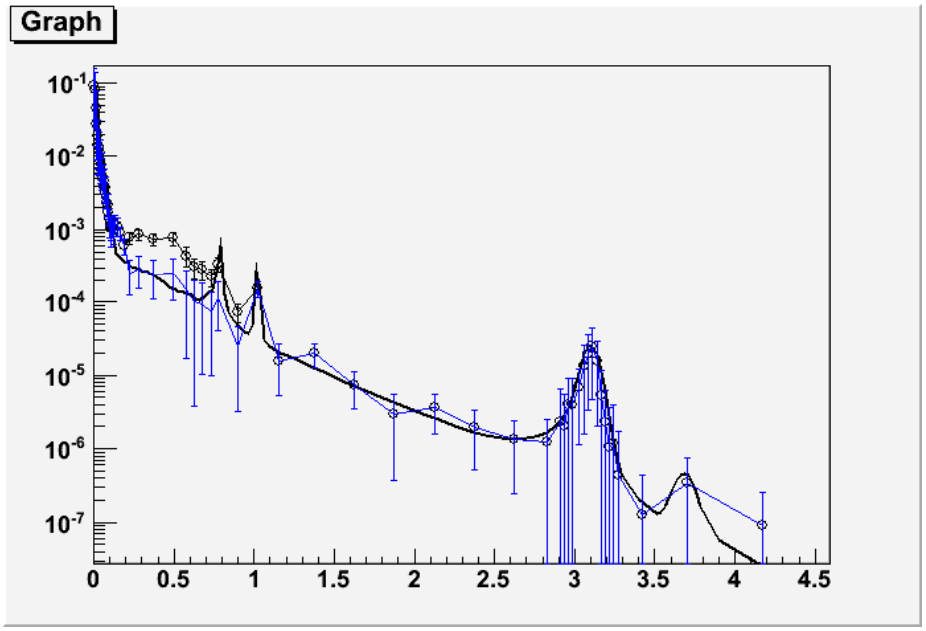
- asked for 1.6 weeks, 50 M events
  - to achieve 10% statistical uncertainty
  - pion R_{AA} at 5 GeV/c p_T

PHENIX Phys. Rev. Lett.101, 162301 (2008)



Onset of Jet Quenching

Enhanced Goal: Dilepton Measurement at 39 GeV

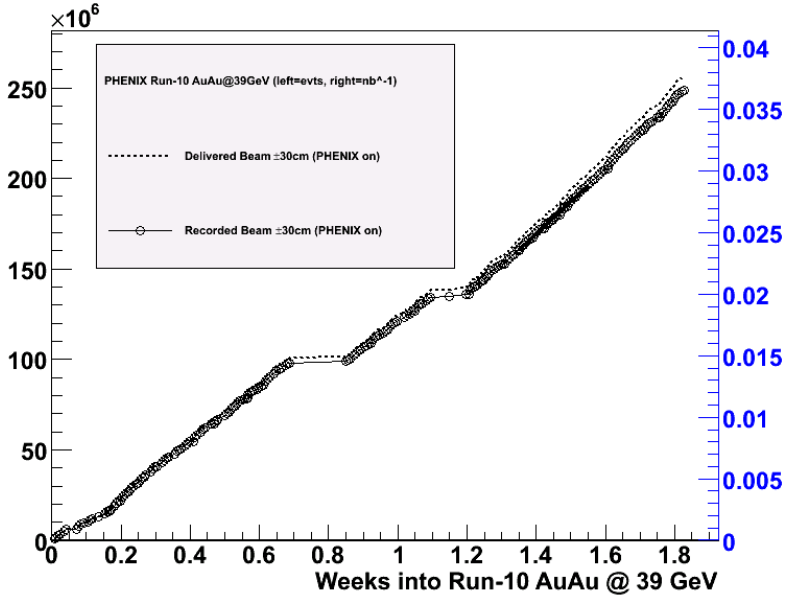


- Performance 2-3x better than expected
- With 200M events in ± 20cm vertex cut
  - If excess is unchanged at 39 GeV
  - Measured excess x4.7 ± 0.77(total); 6 σ result
  - If excess is 1/3 of that at 200 GeV
  - Measured excess x1.57 ± 0.77(total)

*NB: BUP request was 400M

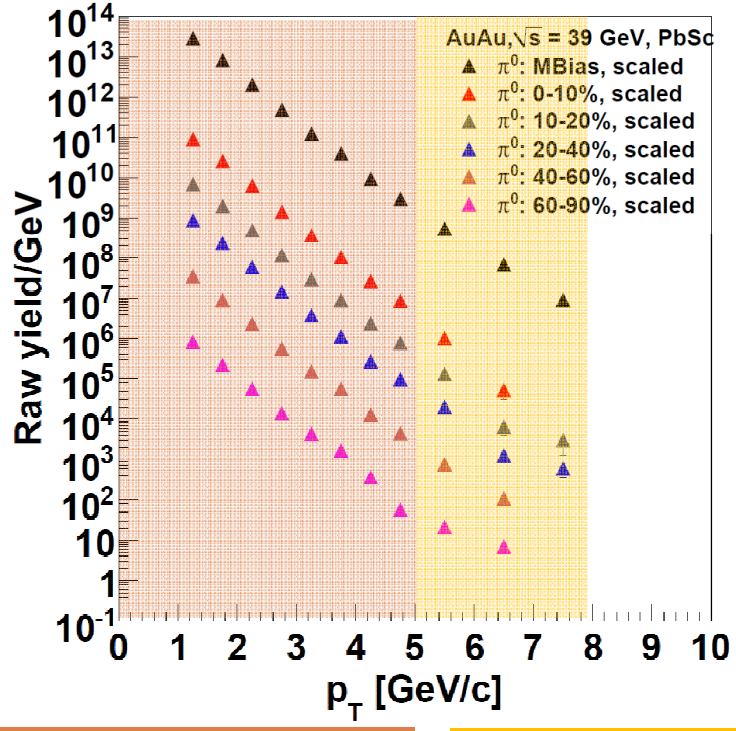
How do dilepton excess and ρ modification at SPS evolve into the large low-mass excess at RHIC?

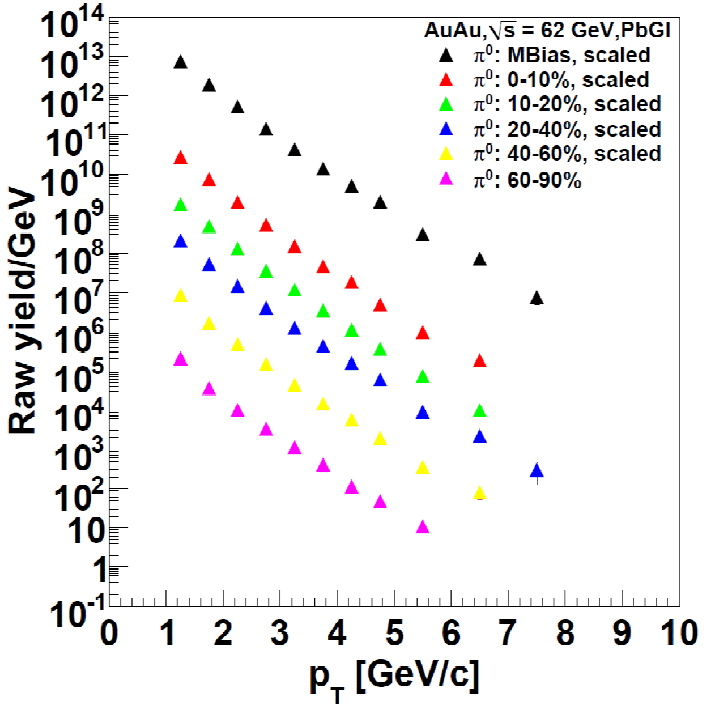
39 GeV: Apr 9 – Apr 22



- Achieved 250 M events in 1.9 weeks
- Both light quark R_{AA} and dilepton measurement goals met

π^0 yields (uncorrected) at 39 GeV





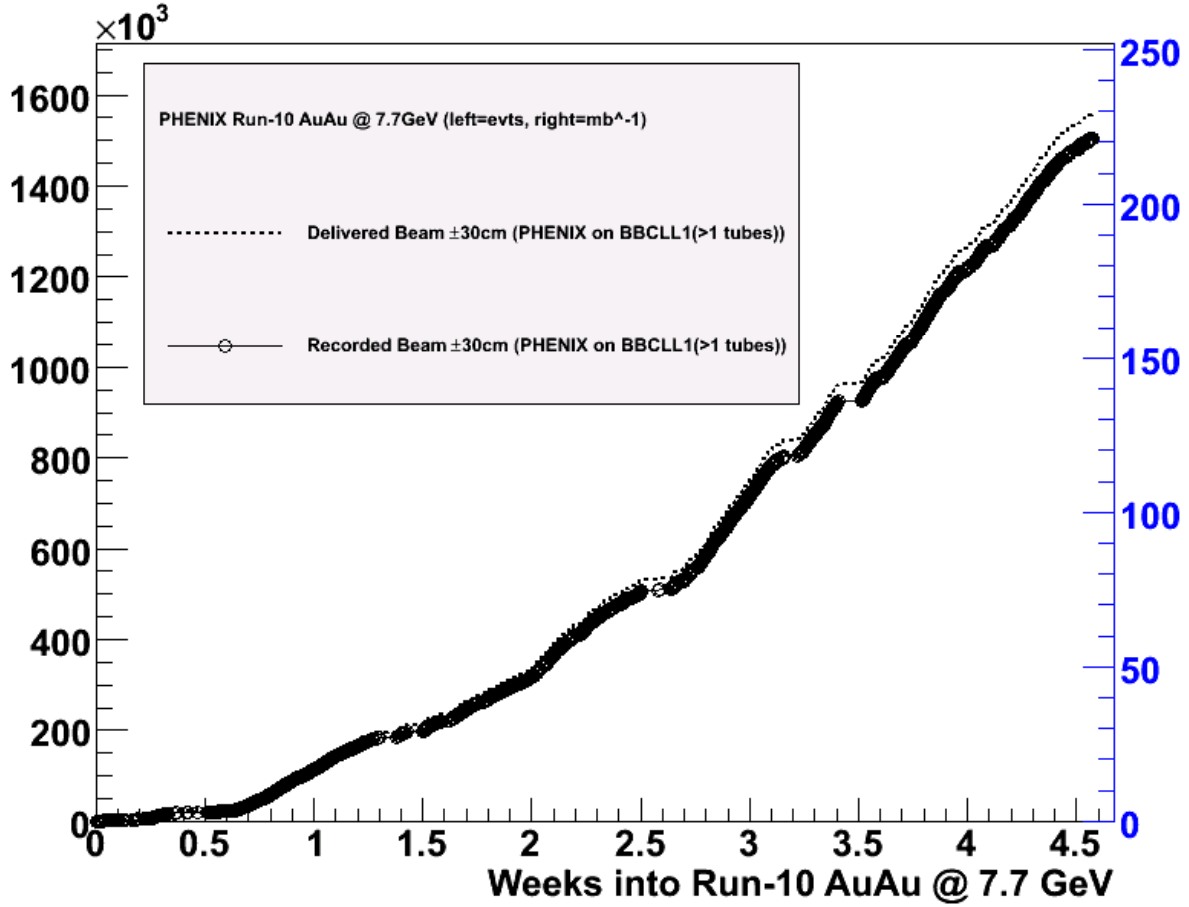
desired p_T reach

Extra p_T reach

39 GeV success—Now on to 7.7 GeV

7.7 GeV: April 25—May 27

BBCLL1(>1 tubes)

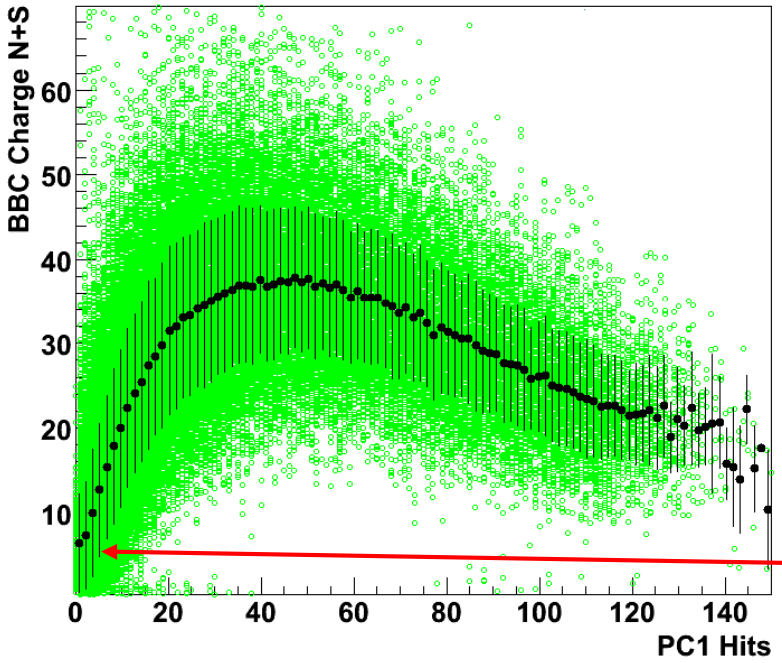


1.5 M minimum bias events recorded @ 7.7 GeV (twice better than expected)

$\sqrt{s_{NN}}$	Fluctuations in $\langle n \rangle$	Fluctuations in $\langle p_t \rangle$	PID spectra, identified particle ratios	longitudinal density correlations critical exponent η
5.5	0.01	0.03	0.03	2
7.7	0.01	0.03	0.02	2

Particle production and fragmentation at 7.7 GeV

forward



90 degrees

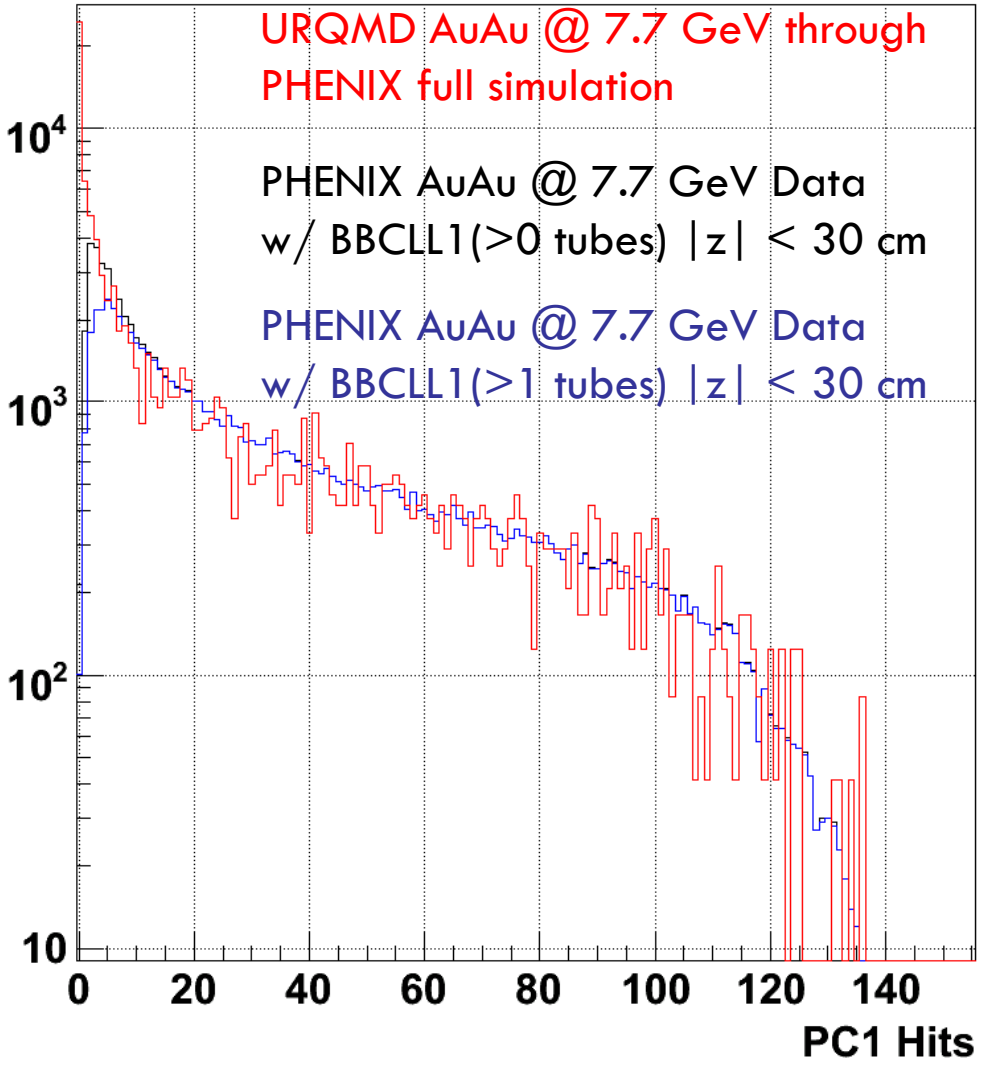
Run-10 AuAu @ 7.7 GeV

72,078 events total up to Run Number 315,999 passing BBCLL1(>1 tubes) and |z| < 30 cm.

Is there hidden background?

Very similar to what was seen at 9 GeV and expected from URQMD + fragmentation model

Background check: negative



URQMD normalized to match real data integral for PC1 hits > 40.

URQMD not matched to z distribution in real data. **<u>However, note that there is no rescaling of the x-axis.</u>**

Then comparing the integrals implies (as a first look) that the BBCLL1(>0 tubes) fires on 77% of the cross section and the BBCLL1(> 1 tubes) fires on 70% of the cross section.

No indication of deviation at low PC1 hits from background (at least by this particular check).

7.7 GeV success—Now on to 11.5

No, wait, no collisions in PHENIX

On to RPC commissioning . . .

Muon Trigger Commissioning

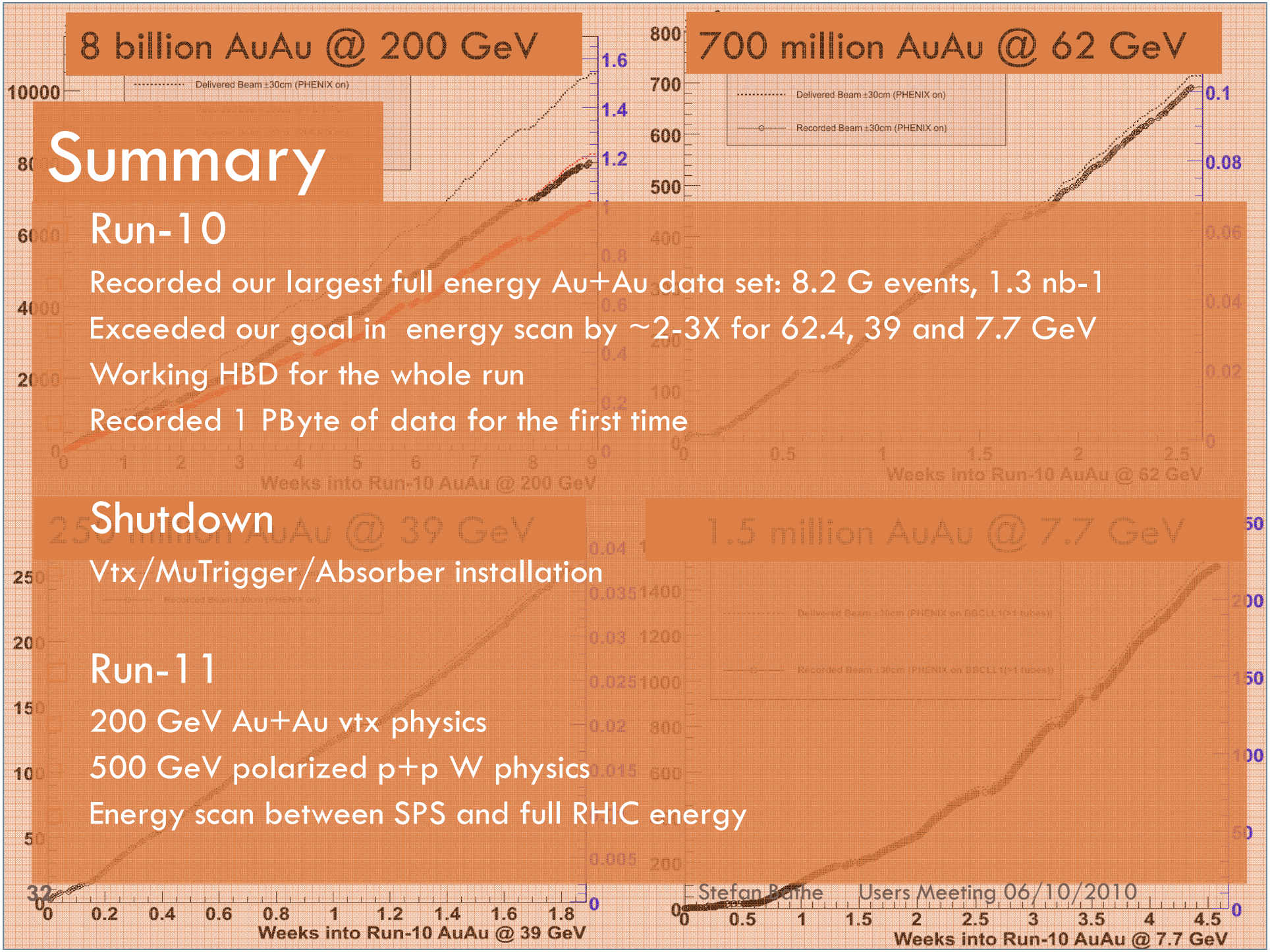
- No collisions in PHENIX @ 11.5 GeV
- Commissioned new muon detectors with cosmic rays instead

- Crucial for next year's W physics program

What's next?

Shutdown and Run-11

- Run-10 ended yesterday
- 2010 Shutdown
  - New Beam pipe
  - VTX installation
  - MuTrg St3 S installation
  - Stainless steel Absorber installation
  - EvB/DCM II Upgrade
  - General Maintenance (DC, MuTracker, EMCal…)
- Run-11 starts early Dec 2010; PHENIX BUP:
  - 200 GeV Au+Au for VTX
  - 500 GeV p+p for MuTrg (W measurement)
  - Short U+U run with EBIS
  - Either Au+Au energy scan continued (27, 18 GeV) or p+p energy scan comparison data



Summary

Run-10

Recorded our largest full energy Au+Au data set: 8.2 G events, 1.3 nb-1

Exceeded our goal in energy scan by ~2-3X for 62.4, 39 and 7.7 GeV

Working HBD for the whole run

Recorded 1 PByte of data for the first time

Shutdown

Vtx/MuTrigger/Absorber installation

Run-11

200 GeV Au+Au vtx physics

500 GeV polarized p+p W physics

Energy scan between SPS and full RHIC energy

Acknowledgements

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- We acknowledge support from
  - the Office of Nuclear Physics in DOE Office of Science, NSF, and a sponsored research grant from Renaissance Technologies (USA)
  - MEXT and JSPS (Japan)
  - CNPq and FAPESP (Brazil), NSFC (China), MSMT (Czech Republic), IN2P3/CNRS and CEA (France), BMBF, DAAD, and AvH (Germany), OTKA (Hungary), DAE and DST (India), ISF (Israel), NRF (Korea), MES, RAS, and FAAE (Russia), VR and KAW (Sweden), U.S. CRDF for the FSU, US-Hungary Fulbright, and US-Israel BSF.
- I thank Baruch College, CUNY and RBRC